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DRAWINGS ATTACHED.

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COMPLETE SPECIFICATION.

Improvements in or relating to Means for Measuring Torque.

We, HERBERT STANLEY PETCH, a Subject of the Queen of Great Britain, of "Maesdown", Brightlands Road, Reigate, in the County of Surrey, and LONDON ELECTRICITY BOARD, a Body Corporate established by The Electricity Act, 1947, of 46 New Broad Street, London, E.C.2, do hereby declare the invention, for which we pray that a patent may be granted to us, and the method by which it is to be performed, to be particularly described in and by the following statement:—

This invention relates to improvements in means for measuring torque and is particularly concerned with such means for providing a measure of the maximum torque to which an element is subjected during an interval of time.

It is an object of the present invention to provide an improved means for providing a measure of the maximum torque to which an element is subjected during an interval of time which means shall be relatively simple and economic to manufacture, robust in use and which shall not require continuously moving parts.

According to the present invention means for providing a measure of the maximum torque to which an element is subjected during an interval of time comprising a rotatable member operatively connected to the element to be rotated by the latter in one direction under the influence of the torque, spring means arranged to oppose rotation of the member in said one direction whereby the latter is capable of assuming an angular balanced position representing the magnitude of the torque in which position the effects of the torque and the spring means on the member are equal and opposite, means for preventing the member rotating in a direction opposite to said one direction and delay means operative to oppose rotation of said member in said one direction, the effect of said delay means on the member being arranged to decay as a function of a predetermined period of time.

Preferably the rotatable member is connected to the element through means which may be disengaged to enable the member to be reset to a zero position after the interval of time whilst the element is being subjected to a torque.

Conveniently the disengaging means includes a differential gear.

Advantageously the delay means comprises a fluid damping device.

The means of the present invention is particularly, but not exclusively, applicable to providing a measure of the maximum load taken by a consumer installation from an electric supply system during an interval of time and an instrument for this purpose will now be described by way of example, reference being made to the single Figure of the drawing accompanying the Provisional Specification which illustrates the instrument somewhat diagrammatically.

The instrument comprises a disc 1 carried on a spindle 2 which disc tends to rotate in one direction under the influence of the power being taken by the consumer installation from the supply system. The torque to which the disc 1 and spindle 2 are subjected is a function of this power. The spindle 2 carries a pinion 3 which engages a crown wheel 4 carried on a shaft 5. The shaft 5 carries a toothed wheel 6 the teeth of which are engaged by a pawl 7 whereby rotation of the shaft 5 in a direction opposite to that in which it tends to rotate under the influence of the torque to which the disc 1 and spindle 2 are subjected is prevented. The shaft 5 also carries a gear 8 secured thereon and a bevel gear 9 which meshes with a further bevel gear 10. The bevel gear

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10 is connected to damping means indicated generally at 11 which tends to oppose the rotation of the shaft 5. This damping means 11 conveniently comprises a suitably shaped plate 12 connected to the bevel gear 10 by a spindle 13 and a further suitably shaped plate 14 the position of which relative to the plate 12 may be adjusted by means of an adjusting nut 15. The two plates 12 and 14 are immersed in a fluid such as a silicone fluid and rotation of the plate 12 due to rotation of the bevel gear 10 is opposed by the viscosity of the fluid, the effect of the damping means upon the rotation of the bevel gear 10 and shaft 5 decaying exponentially as a function of a predetermined period of time which is controlled by selecting the fluid to have a suitable viscosity and by adjusting the relative positions of the plates 12 and 14. This predetermined period of time is of the order of thirty minutes. The gear 8 meshes with a further gear 16 carried on a sleeve 17 which is free to rotate on a further shaft 18. The sleeve 17 carries a bevel gear 18*a* forming part of a differential gear which includes bevel gears 19 and 20. The bevel gear 19 is carried on a sleeve 21 which is free to rotate on the shaft 18 and the bevel gear 20 engages both gears 18*a* and 19 and is carried for rotation on a shaft 22 secured to the shaft 18. The sleeve 21 also carries a bevel gear 23 which meshes with a further bevel gear 24 carried on a spindle 25 normally held against rotation by clip means 26 so that the sleeve 21 and the bevel gear 19 are normally held against rotation and rotation of the gear 18*a* causes the gear 20 to rotate about its axis and to revolve about the axis of the shaft 18 thereby rotating the latter. As the shaft 5 can only rotate in one direction the shaft 18 can only be rotated through the differential gears 18*a*, 19 and 20 in one direction and spring means 27 is provided to oppose rotation in this direction. The shaft 18 carries a pointer 28 which moves over a scale 29 to provide an indication of the angular position of the shaft 18 and hence a measure of the maximum load taken by the consumer installation from the supply system.

The operation of the instrument described is as follows. When a consumer installation takes power from the supply system after the commencement of an interval of time, a torque is exerted on the disc 1 and spindle 2 which is a function of the power being taken. This torque, in the absence of the damping means 11, would cause the spindle 2 to rotate and this rotation would be transmitted through the shaft 5, gearing 8, 16, 18*a*, 19 and 20 to the shaft 18 and hence to the indicator 28 which would assume a balanced position relative to the scale 29 representing the magnitude of the power being taken and in which position the torque transmitted to the shaft 18 would be balanced by the effect of the spring means 27. However, the torque is initially opposed by the damping means 11 the effect of which decays exponentially as a function of a predetermined period of time and which is zero at the end of this predetermined period of time which is usually of the order of thirty minutes. Thus the damping means delays the full effect of the torque on the shaft 18. If the consumer installation takes a steady load for the predetermined period of time then at the end of this period the pointer 28 will have attained a position relative to the scale 29 which represents that load or power.

If, however, during this predetermined period of time the load is suddenly increased for a short period and then returns to the steady value the pointer 28 will initially be displaced from the zero position under the influence of the initial steady load at a rate which is a function of the value of the magnitude of the steady load, the predetermined period of time and the time during which the steady load is supplied. Before it reaches the steady position representing the magnitude of the load or power taken from the supply the torque will be increased due to the increased load and the pointer 28 will then continue its displacement at a rate which is a function of the magnitude of the increased load, the predetermined interval of time and the time during which the increased load is supplied. Before the pointer reaches a steady position corresponding to the increased load the load returns to its previous steady value. If at this instant the torque exerted on the shaft 18 is less than the effect of the spring means 27 thereon, then the pointer 28 will remain steady as it cannot return towards its initial position due to the pawl 7 and toothed wheel 6. If, however, at this instant the torque exerted on the shaft 18 is greater than the effect of the spring means 27 thereon the pointer 28 will continue its displacement until the torque and the effect of the torque on the spring means 27 on the shaft 18 balance out. When the instrument is read at the end of the interval of time which may be of the order of one, two or even three months, the displacement of the pointer 28 from its zero position will be a measure of the maximum torque exerted on the shaft 18 and hence of the maximum load taken from the supply system by the consumer installation. For any maximum load during this period the instrument will give a maximum reading when the maximum load has been supplied for a continuous period of time equal to or greater than the predetermined period of time.

When the instrument has been read the reader releases the spindle 25 by withdrawing the clip means 26 and manually rotates

the spindle 25 to rotate the bevel gears 24, 23 and 19 and drive the bevel gear 20 and rotate the shaft 18 and return the latter to its initial zero position together with the pointer 28. When this has occurred the shaft 25 is again held against rotation by inserting the clip means 26 and the instrument is reset for a further interval of time. It will be appreciated that the instrument may be reset whilst the consumer installation is drawing power from the supply system.

WHAT WE CLAIM IS:—

1. Means for providing a measure of the maximum torque to which an element is subjected during an interval of time comprising a rotatable member operatively connected to the element to be rotated by the latter in one direction under the influence of the torque, spring means arranged to oppose rotation of the member in said one direction whereby the latter is capable of assuming an angular balanced position representing the magnitude of the torque in which position the effects of the torque and the spring means on the member are equal and opposite, means for preventing the member rotating in a direction opposite to said one direction and delay means operative to oppose rotation of said member in said one direction, the effect of said delay means on the member being arranged to decay as a function of a predetermined period of time.

2. Means according to Claim 1 wherein the rotatable member is connected to the element through means which may be disengaged to enable the member to be reset to a zero position after the interval of time whilst the element is being subjected to a torque.

3. Means according to Claim 2 wherein the disengaging means includes a differential gear.

4. Means according to Claim 1, 2 or 3 wherein the rotatable member is carried on a first shaft for rotation therewith about the axis thereof, the element is arranged to drive a second shaft when subjected to the torque and gear means is provided on said first and second shafts to transmit the drive from the second shaft to the first shaft.

5. Means accordings to Claims 3 and 4 wherein the differential gear is associated with the first shaft.

6. Means according to Claim 4 or 5 wherein the means for preventing the member rotating in a direction opposite to said one direction comprises a toothed wheel carried on said second shaft and a pawl engaged with said toothed wheel.

7. Means according to Claim 4, 5 or 6 wherein the element is carried on a spindle for rotation therewith about the axis thereof and means is provided to transmit the drive from the spindle to the second shaft.

8. Means according to Claim 7 wherein the means for transmitting the drive from the spindle to the second shaft comprises a crown wheel and pinion.

9. Means according to any one of Claims 4 to 8 wherein the delay means is associated with said second shaft.

10. Means according to any one of Claims 4 to 9 wherein said gear means comprises a first gear carried on said second shaft for rotation therewith about the axis thereof, a further gear in mesh with said first gear and carried on a sleeve rotatably mounted with respect to and about the axis of said first shaft, the differential gear comprises a first bevel gear carried on said sleeve, a second bevel gear carried on a further sleeve which is rotatably mounted with respect to and about the axis of said first shaft and a third bevel gear meshing with both said first and second bevel gears and secured to said first shaft such that rotation of said third bevel gear produces rotation of said first shaft about its axis and wherein releasable means is provided arranged normally to hold said further sleeve against rotation.

11. Means according to Claim 10 wherein the releasable means comprises a fourth bevel gear carried on said further sleeve and non-rotatable with respect thereto, a fifth bevel gear meshing with said fourth bevel gear and means for preventing rotation of said fifth bevel gear.

12. Means according to any one of Claims 4 to 11 wherein the spring means is associated with said first shaft.

13. Means according to any one of Claims 4 to 12 wherein the delay means comprises a fluid damping device.

14. Means according to any one of Claims 1 to 13 wherein the effect of the delay means is arranged to decay exponentially.

15. Means according to any one of Claims 1 to 14 as applied to providing a measure of the maximum load taken by a consumer installation from an electric supply system.

16. Means according to Claim 15 wherein the element is a disc subjected to the influence of the power being taken by the consumer installation.

17. Means according to Claim 15 or 16 wherein the rotatable member is a pointer movable over a scale.

18. Means according to Claim 1 constructed, arranged and adapted to operate substantially as hereindescribed with reference to the drawing accompanying the Provisional Specification.

For the Applicants,
RAWORTH, MOSS & COOK,
Chartered Patent Agents,
75 Victoria Street,
London, S.W.1.

PROVISIONAL SPECIFICATION.

Improvements in or relating to a Method of and Means for Measuring Torque.

We, HERBERT STANLEY PETCH, a Subject of the Queen of Great Britain, of "Maesdown", Brightlands Road, Reigate, in the County of Surrey, and LONDON ELECTRICITY BOARD, a Body Corporate established by The Electricity Act, 1947, of 46 New Broad Street, London, E.C.2, do hereby declare this invention to be described in the following statement:—

This invention relates to improvements in a method of and means for measuring torque and is particularly concerned with such method and means for providing a measure of the maximum torque to which an element is subjected during an interval of time.

It is an object of the present invention to provide an improved method of and means for providing a measure of the maximum torque to which an element is subjected during an interval of time which method shall be relatively simple to carry into effect and which means shall be relatively simple and economic to manufacture, robust in use and which shall not require continuously moving parts.

According to one feature of the present invention a method of providing a measure of the maximum torque to which an element is subjected during an interval of time comprises subjecting a rotatable member to the torque to rotate the member in one direction in opposition to the influence of spring means whereby the member is capable of assuming an angular balanced position representing the magnitude of the torque in which position the effects of the torque and the spring means on the member are equal and opposite, preventing said member from rotating in a direction opposite to said one direction and further opposing the rotation of the member in said one direction by delay means the effect of which decays as a function of a predetermined period of time.

The effect of the delay means conveniently decays exponentially.

According to another feature of the present invention means for providing a measure of the maximum torque to which an element is subjected during an interval of time comprising a rotatable member operatively connected to the element to be rotated by the latter in one direction under the influence of the torque, spring means arranged to oppose rotation of the member in said one direction whereby the latter is capable of assuming an angular balanced position representing the magnitude of the torque in which position the effects of the torque and the spring means on the member are equal and opposite, means for preventing the member rotating in a direction opposite to said one direction and delay means operative to oppose rotation of said member in said one direction, the effect of said delay means on the member being arranged to decay as a function of a predetermined period of time.

Preferably the rotatable member is connected to the element through means which may be disengaged to enable the member to be reset to a zero position after the interval of time whilst the element is being subjected to a torque.

Conveniently the disengaging means includes a differential gear.

Advantageously the delay means comprises a fluid damping device.

The method and means of the present invention are particularly, but not exclusively, applicable to providing a measure of the maximum load taken by a consumer installation from a supply system during an interval of time and instrument for this purpose will now be described by way of example, reference being made to the single figure of the accompanying drawing which illustrates the instrument somewhat diagrammatically.

The instrument comprises a disc 1 carried on a spindle 2 which disc tends to rotate in one direction under the influence of the power being taken by the consumer installation from the supply system. The torque to which the disc 1 and spindle 2 are subjected is a function of this power. The spindle 2 carries a pinion 3 which engages a crown wheel 4 carried on a shaft 5. The shaft 5 carries a toothed wheel 6 the teeth of which are engaged by a pawl 7 whereby rotation of the shaft 5 in a direction opposite to that in which it tends to rotate under the influence of the torque to which the disc 1 and spindle 2 are subjected is prevented. The shaft 5 also carries a gear 8 secured thereon and a bevel gear 9 which meshes with a further bevel gear 10. The bevel gear 10 is connected to damping means indicated generally at 11 which tends to oppose the rotation of the shaft 5. This damping means 11 conveniently comprises a suitably shaped plate 12 connected to the bevel gear 10 by a spindle 13 and a further suitably shaped plate 14 the position of which relative to the plate 12 may be adjusted by means of an adjusting nut 15. The two plates 12 and 14 are immersed in a fluid such as a silicone fluid and rotation of the plate 12 due to rotation of the bevel gear 10 is opposed by the viscosity of the fluid, the effect of the damping means upon the rota-

tion of the bevel gear 10 and shaft 5 decaying exponentially as a function of a predetermined period of time which is controlled by selecting the fluid to have a suitable viscosity and by adjusting the relative positions of the plates 12 and 14. This predetermined period of time is of the order of thirty minutes. The gear 8 meshes with a further gear 16 carried on a sleeve 17 which is free to rotate on a further shaft 18. The sleeve 17 carries a bevel gear 18*a* forming part of a differential gear which includes bevel gears 19 and 20. The bevel gear 19 is carried on a sleeve 21 which is free to rotate on the shaft 18 and the bevel gear 20 engages both gears 18*a* and 19 and is carried for rotation on a shaft 22 secured to the shaft 18. The sleeve 21 also carries a bevel gear 23 which meshes with a further bevel gear 24 carried on a spindle 25 normally held against rotation by clip means 26 so that the sleeve 21 and the bevel gear 19 are normally held against rotation and rotation of the gear 18*a* causes the gear 20 to rotate about its axis and to revolve about the axis of the shaft 18 thereby rotating the latter. As the shaft 5 can only rotate in one direction the shaft 18 can only be rotated through the differential gears 18*a*, 19 and 20 in one direction and spring means 27 is provided to oppose rotation in this direction. The shaft 18 carries a pointer 28 which moves over a scale 29 to provide an indication of the angular position of the shaft 18 and hence a measure of the maximum load taken by the consumer installation from the supply system.

The operation of the instrument described is as follows. When a consumer installation takes power from the supply system after the commencement of an interval of time, a torque is exerted on the disc 1 and spindle 2 which is a function of the power being taken. This torque, in the absence of the damping means 11, would cause the spindle 2 to rotate and this rotation would be transmitted through the shaft 5, gearing 8, 16, 18*a*, 19 and 20 to the shaft 18 and hence to the indicator 28 which would assume a balanced position relative to the scale 29 representing the magnitude of the power being taken and in which position the torque transmitted to the shaft 18 would be balanced by the effect of the spring means 27. However, the torque is initially opposed by the damping means 11 the effect of which decays exponentially as a function of a predetermined period of time and which is zero at the end of this predetermined period of time which is usually of the order of thirty minutes. Thus the damping means delays the full effect of the torque on the shaft 18. If the consumer installation takes a steady load for the predetermined period of time then at the end of this period the pointer 28 will have attained a position relative to the scale 29 which represents that load or power.

If, however, during this predetermined period of time the load is suddenly increased for a short period and then returns to the steady value the pointer 28 will initially be displaced from the zero position under the influence of the initial steady load at a rate which is a function of the value of the magnitude of the steady load, the predetermined period of time and the time during which the steady load is supplied. Before it reaches the steady position representing the magnitude of the load or power taken from the supply the torque will be increased due to the increased load and the pointer 28 will then continue its displacement at a rate which is a function of the magnitude of the increased load, the predetermined interval of time and the time during which the increased load is supplied. Before the pointer reaches a steady position corresponding to the increased load the load returns to its previous steady value. If at this instant the torque exerted on the shaft 18 is less than the effect of the spring means 27 thereon, then the pointer 28 will remain steady as it cannot return towards its initial position due to the pawl 7 and toothed wheel 6. If, however, at this instant the torque exerted on the shaft 18 is greater than the effect of the spring means 27 thereon the pointer 28 will continue its displacement until the torque and the effect of the torque on the spring means 27 on the shaft 18 balance out. When the instrument is read at the end of the interval of time which may be of the order of one, two or even three months, the displacement of the pointer 28 from its zero position will be a measure of the maximum torque exerted on the shaft 18 and hence of the maximum load taken from the supply system by the consumer installation. For any maximum load during this period the instrument will give a maximum reading when the maximum load has been supplied for a continuous period of time equal to or greater than the predetermined period of time.

When the instrument has been read the reader releases the spindle 25 by withdrawing the clip means 26 and manually rotates the spindle 25 to rotate the bevel gears 24, 23 and 19 and drive the bevel gear 20 and rotate the shaft 18 and return the latter to its initial zero position together with the pointer 28. When this has occurred the

shaft 25 is again held against rotation by inserting the clip means 26 and the instrument is reset for a further interval of time. It will be appreciated that the instrument may be reset whilst the consumer installation is drawing power from the supply system.

For the Applicants,
RAWORTH, MOSS & COOK,
Chartered Patent Agents,
75 Victoria Street,
London, S.W.1.

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827,212 PROVISIONAL SPECIFICATION

1 SHEET

This drawing is a reproduction of the Original on a reduced scale.